Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
01 JUN 2007	**N/A**	

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Things that go boom: injuries from explosives	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
Eastridge B. J. /	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	8. PERFORMING ORGANIZATION REPORT NUMBER
United States Army Institute of Surgical Research, JBSA Fort Sam Houston, TX 78234	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**UU**	**1**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

Things That Go Boom: Injuries From Explosives

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J Trauma. 2007;62:S38.

Explosive agents are materials that undergo rapid exothermic reaction when appropriately stimulated. The degree to which this reaction occurs is dependent upon the characteristics of the explosive agent. Low order explosives react by rapid burning or conflagration. On the other hand, high order explosives produce extreme heat and energy and result in the formation of a pressure wave or "blast wave." This supersonic, superheated wave, known as "overpressure" comprises the blast front (Fig. 1). The blast wave is reflected and sustained by fixed structures and confined environments such as rooms, vehicles, etc., and may portend the effects of blast-related injury. By the same mechanism, water, which is a relatively noncompressible medium, sustains more of the energy from the blast energy and as such blast waves in water have a greater injurious effect propagated over a greater distance. The three main factors which characterize the blast wave are peak rate of pressure rise, peak pressure, and duration of the pressure rise.

Injuries from explosive agents are characterized by mechanism of injury associated with the explosive event. Primary blast injuries are those injuries associated with the blast wave itself. It should be noted that by this definition, true blast injury is only a subset of all injuries caused by explosions. The mechanism of injury in blast is the impartation of heat and energy to the body, particularly, air filled organs, by the blast wave itself. Survival and injury from primary blast injury is contingent upon a number of factors including energy of the blast, confined versus open space and standoff distance from the explosive source. Survivable blast injuries are characterized by tympanic membrane rupture, pulmonary barotraumas, bowel contusion and perforation, and concussive brain injury. The secondary explosive injuries

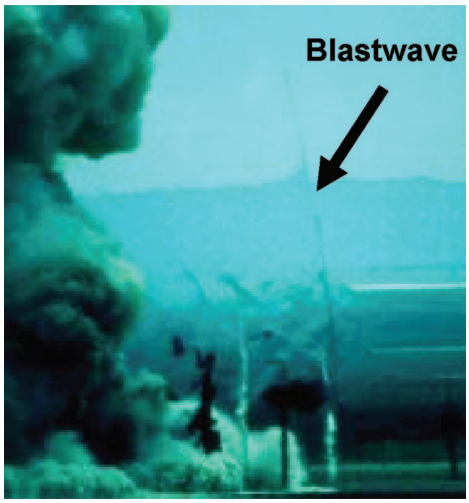

Fig. 1. *The blast front.*

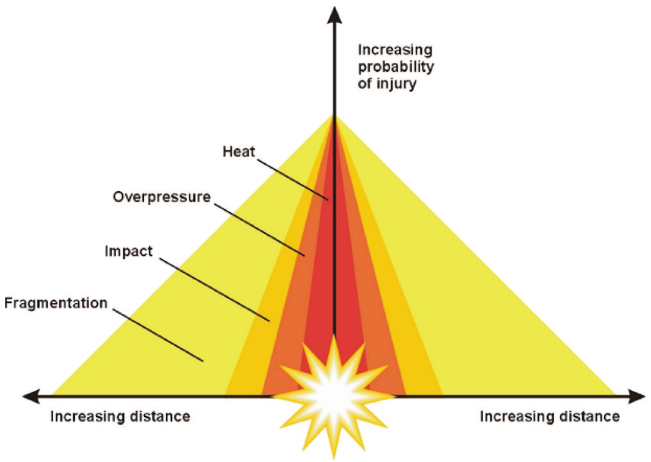

Fig. 2. *Standoff distance from the explosive source.*

are fragmentation injuries from the casing of the explosive or secondary debris. Most are penetrating injuries and often are associated with multiple penetrations of the victim. Tertiary explosive injuries are those injuries caused by physical displacement of the victim, usually as a result of the attenuated energy from the blast wave. Lastly, quaternary effects are burns, inhalations and exacerbation of underlying conditions.

This article was written for the proceedings from a conference entitled *12th Annual San Antonio Trauma Symposium* in San Antonio, Texas. The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the Department of the Army or the Department of Defense.

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DOI: 10.1097/TA.0b013e318065414f